TECHNICAL NOTES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 249

EFFECT OF PROTRUDING GASOLINE TANKS UPON THE CHARACTERISTICS OF AN AIRFOIL

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Uncertainty as to the effect of a gasoline tank protruding from the center section of a wing upon the aerodynamic characteristics of the wing has led to the testing of such an arrangement in the variable density wind tunnel.

A 5-inch by 30-inch model duralumin airfoil having the Clark Y section, was used for the investigation. Two tank models were made of wood to fit the upper and lower surface of the airfoil. The airfoil was then tested in the usual manner with the tank first fastened to the upper surface and then to the lower surface. The tests were made only at the highest value of the Reynolds Number at which the tunnel is ordinarily operated.

The tank was made to represent roughly that used on the De Havilland "Moth." The tank model was made rectangular in plan form 2 inch by 5 inch, thus covering one-fifteenth of the span. Its section was obtained by fitting one side to the airfoil and then making the thickness at each point along the chord equal to the thickness of the airfoil at that point. A sketch of the section of the airfoil and tank will be found in Fig. 1.

The results are presented by three sets of curves. In Fig. 1 will be found the polar curves; in Fig. 2, the curves of D/L against lift coefficient; and in Fig. 3, the curves of lift and drag coefficient against the angle of attack. On each sheet are given the curves representing the characteristics of the airfoil without the tank, with the tank on the upper surface, and with the tank on the lower surface.

It was the original intention to test only the airfoil with the tank on the upper surface. However, since the drag was increased by such a large amount at the higher values of the lift coefficient, it was thought that the detrimental effect of the tank could be reduced by placing it on the lower surface. This, indeed, proved to be the case with respect to the drag, but the maximum lift was not increased in spite of the fact that the airfoil went to higher angles before burbling commenced. The minimum drag was also slightly reduced by changing the position of the tank. It will be noted that, for a considerable portion of the range, the drag of the airfoil with the tank below, is only slightly greater than the drag of the airfoil alone. However, the maximum lift is about 7.7 per cent lower.

The results of these tests show clearly the importance of considering interference effects arising from objects which protrude from the lower or the upper surface of an airfoil. The particular case which was investigated indicates that the detrimental effect is less when the object protrudes from the lower surface.

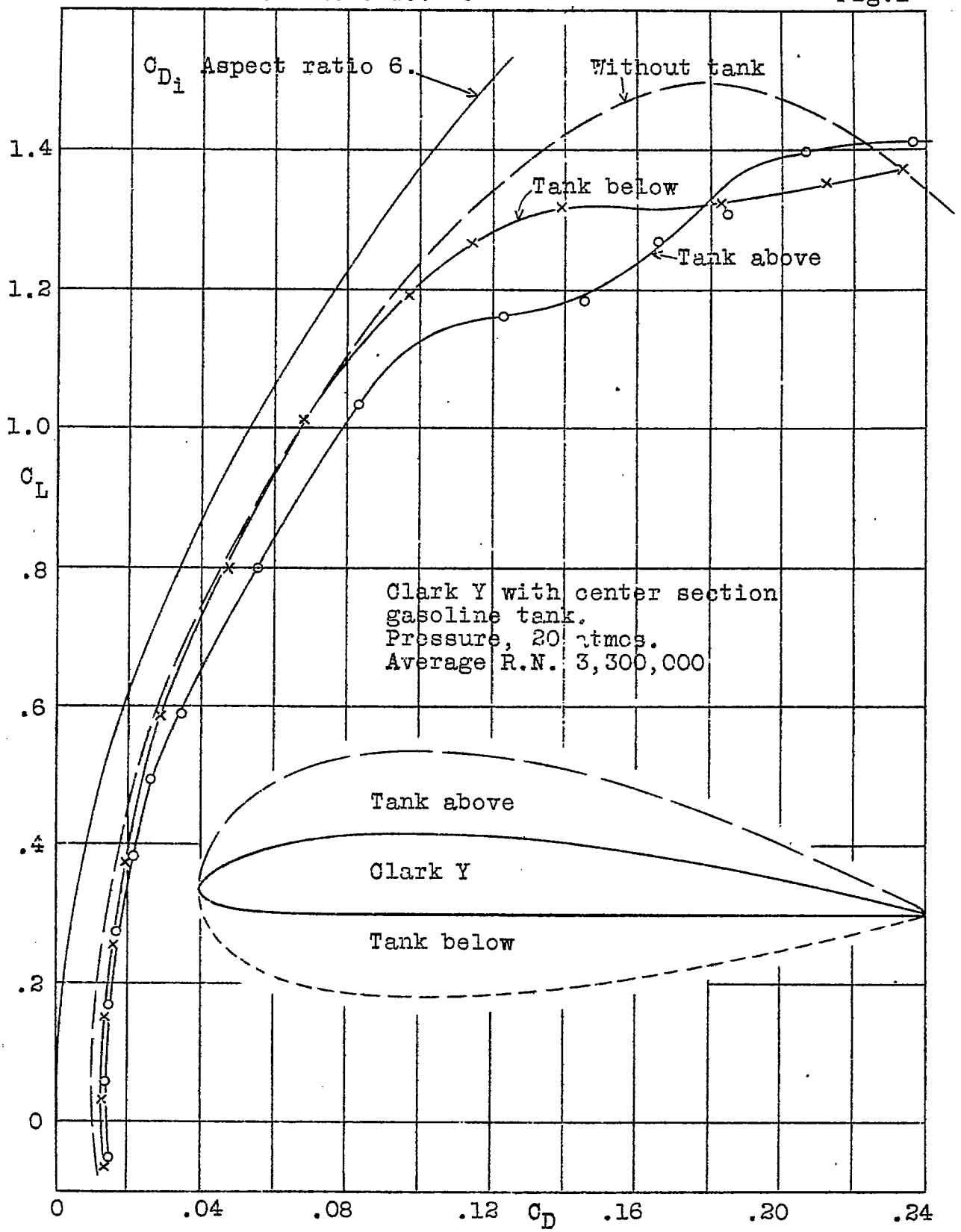
C_{D_i} Aspect ratio 6.
Without tank
Tank below
Tank above
Clark Y with center section gasoline tank.
Pressure, 20 atmos.
Average R.N. 3,300,000
Tank above
Clark Y
Tank below
1.4
1.2
1.0
C_L
.8
.6
.4
.2
0
0
.04
.08
.12
C_D
.16
.20
.24

Fig.1

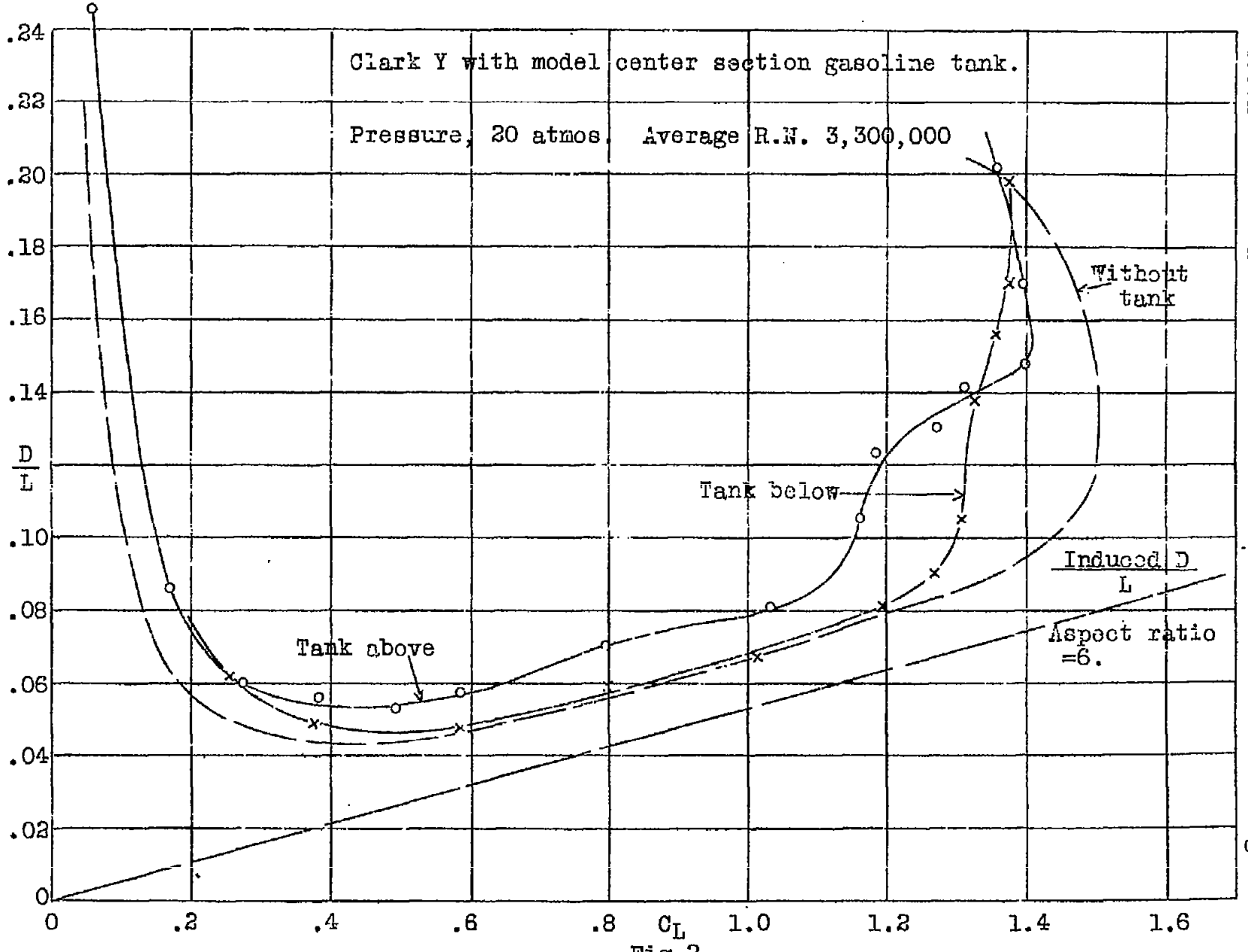
Clark Y with model center section gasoline tank.
Pressure, 20 atmos. Average R.N. 3,300,000
Without tank
Tank below
Tank above
Induced D/L
Aspect ratio =6.
D/L
C_L
0
.02
.04
.06
.08
.10
.14
.16
.18
.20
.22
.24
.2
.4
.6
.8
1.0
1.2
1.4
1.6

Fig.3

Fig.2

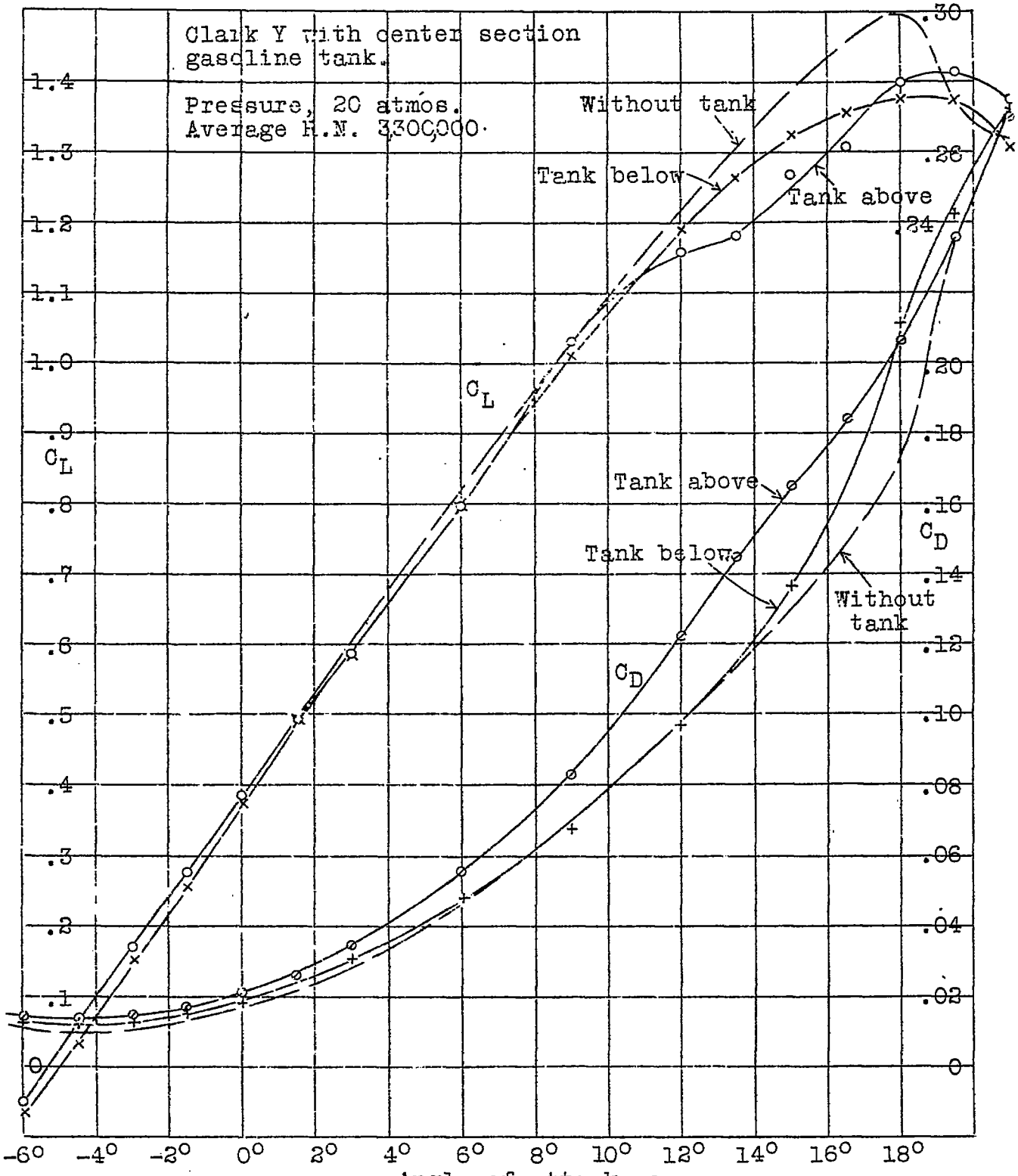
Clark Y with center section gasoline tank.
Pressure, 20 atmos.
Average R.N. 3300000.
Without tank
Tank below
Tank above
Tank above
Tank below
Without tank
C_L
C_D
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
.30
.26
.24
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
-6° -4° -2° 0° 2° 4° 6° 8° 10° 12° 14° 16° 18°
Angle of attack, α

Fig.3